

CLAIMS

I claim:

1. A method for writing servo data onto one or more surfaces of one or more disks within a disk drive without using a servo writing machine, comprising:

writing a reference track on a first disk surface using a first recording head of the disk drive;

using a macroactuator that is capable of adjusting the position of both the first recording head and a second recording head of the disk drive, tracking the reference track with the first recording head; and

while the first recording head tracks the reference track, using a microactuator of the second recording head to:

radially displace the second recording head from the first recording head and the reference track; and

write servo data on a second disk surface.

2. The method of claim 1, further comprising:

generating a position error signal from a feedback signal obtained by the first recording head from the reference track; and

using the position error signal to control the microactuator of the second recording head while writing the servo data on the second disk surface.

3. The method of claim 1, further comprising, after writing the servo data on the second disk surface:

using the macroactuator, tracking a reference track on the second disk surface with the second recording head; and

while the second recording head tracks the reference track on the second disk surface, using a microactuator of the first recording head to:

radially displace the first recording head from the second recording head and the reference track on the second disk surface; and

write servo data on a first disk surface.

4. The method of claim 3, further comprising, until all servo data is written, successively

using the microactuator of the first recording head to write other servo data on the first disk surface while the second recording head tracks other reference tracks on the second disk surface; and

using the microactuator on the second recording head to write other servo data on the second disk surface while the first recording head tracks other reference tracks on the first disk surface.

5. The method of claim 1, wherein tracking the reference track with the first recording head comprises generating a position error signal that is used by the microactuator of the second recording head to radially displace the second recording head and write the servo data on the second disk surface.

6. The method of claim 5, wherein the position error signal is inverted and summed to compensate for disk flutter.

7. The method of 1, wherein writing the servo data to the second disk surface comprises writing intermediate fixed data patterns that are positioned between servo wedges and are out-of-phase with respect to adjacent tracks and are used for position control during servo writing.

8. The method of claim 7, wherein:

the data patterns provide a feedback signal for generating a position error signal that is used to control the microactuator of the second recording head; and

the second recording head is radially displaced and the servo data is written to the second disk surface such that the position of servo data on the first disk surface and on the second disk surface is substantially similar.

9. The method of claim 7, wherein writing the servo data to the second disk surface further comprises using the microactuator of the second recording head to position the recording head over the intermediate tracks and for erasing a portion of the servo wedges to obtain half-bit servo wedges.

10. The method of claim 9, wherein erasing a portion of the servo wedges comprises writing an inverse polarity of the servo wedges at a half-track position.

11. The method of claim 9, further comprising, while erasing a portion of the servo wedges, performing a consistency check by detecting any signal interrupts or signal overlaps at the second recording head.

12. The method of claim 1, after all servo data has been written, performing a consistency check by:

testing that servo data on the first disk surface and servo data on the second disk surface is substantially similar by positioning the first and second recording heads over intermediate tracks such that only half of the first and second recording heads are positioned over corresponding tracks; and

measuring and comparing the amplitude of the two corresponding tracks to determine if there is track encroachment or track separation.

13. The method of claim 1, wherein the servo data is written at a disk speed that is less than an operational disk speed of the disk drive.

14. The method of claim 1, wherein the servo data is written during a process of media certification performed on the disk surfaces.

15. A method for writing servo data onto disk surfaces in a disk drive without using a servo writing machine, comprising:

 biasing multiple recording heads of the disk drive at a first reference position;

 positioning a first recording head to follow a first reference track on a surface of a first disk;

 while the first recording head follows the first reference track, using microactuators included in one or more other recording heads to independently move the one or more other recording heads in a radial direction to a position that is offset from the first reference track; and

 writing servo data at the position on one or more disk surfaces using the one or more other recording heads.

16. The method of claim 15, wherein data within the first reference track is written by the first recording head.

17. The method of claim 16, wherein the servo data comprises servo wedges and data patterns, the servo wedges being used for ensuring that a recording head follows a particular track when the disk drive is in operation and the data patterns used for servoing assistance when writing servo data within subsequent data tracks.

18. The method of claim 17, wherein the data patterns are between the servo wedges and out of phase with data patterns within adjacent tracks, and wherein the data patterns provide a feedback signal for generating a position error signal.

19. The method of claim 18, wherein the position error signal defines one or more motions within the disk drive, and wherein the position error signal provides feedback to the microactuators when moving the one or more other recording heads to said position.

20. The method of claim 19, wherein the one or more motions are associated with frequencies from at least one of a spindle motor, base actuator post, a disk in the disk drive and a recording head.

21. The method of claim 20, wherein the frequencies from the disk includes disk flutter or disk vibration.

22. The method of claim 15, wherein the multiple recording heads are biased at the first reference position using a macroactuator arm, and wherein the first reference position is controlled by a crash stop.

23. The method of claim 22, wherein the crash stop limits the motion of the macroactuator arm to an extreme outer diameter of the disk surfaces.

24. The method of claim 15, wherein at least a part of the servo data at the position is later used as feedback to control the positioning of the first recording head to write servo data on a disk surface associated with the first recording head.

25. The method of claim 15, wherein the servo data at said position includes servo wedges used for computing an error signal for macroactuator and microactuator tracking when the disk drive is in operation, and wherein the servo wedges are converted into half bits by offsetting the multiple recording heads by a half track position and writing an inverse polarity of the servo wedges.

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26. In a disk drive that has multiple recording heads for reading and writing data on disk surfaces of one or more disks, a method for writing servo data on the different disk surfaces without requiring a servo writing machine or clean room conditions, wherein at least a portion of the servo data is used in fine track positioning the multiple recording heads when the disk drive is in operation, the method comprising:

moving a macroactuator assembly that controls macro positioning for multiple recording heads to a first reference position;

while the macroactuator assembly remains at the first reference position writing a first reference track on a first disk surface using a first recording head

centering the first recording head on the first reference track and, while following the first reference track by the first recording head, applying feedback from the first recording head to a microactuator in each of one or more other recording heads from the multiple recording heads; and

in response to the feedback, using the microactuator in each of the one or more other recording heads to independently move the one or more other recording heads in a radial direction to write servo data on one or more disk surfaces associated with the one or more other recording heads.

27. The method of claim 26, wherein the servo data comprises servo wedges and data patterns, the servo wedges being used for ensuring that a recording head follows a particular track when the disk drive is in operation and the data patterns being used for servoing assistance when writing servo data within subsequent data tracks.

28. The method of claim 27, wherein the data patterns are positioned between the servo wedges and are out-of-phase with data patterns within adjacent tracks, and wherein the data patterns provide a feedback signal for generating a position error signal.

29. The method of claim 28, wherein the position error signal is responsive to one or more motions within the disk drive, and wherein the position error signal is used to control the microactuators of the one or more other recording heads when writing the servo data.

30. The method of claim 29, wherein the one or more motions are associated with frequencies from at least one of a spindle motor, base actuator post, a disk in the disk drive and a recording head.

31. The method of claim 26, wherein the servo data includes servo wedges used for computing an error signal for macroactuator and microactuator tracking when the disk drive is in operation, and wherein the servo wedges are converted into half bits by offsetting the multiple recording heads by a half track position and writing an inverse polarity of the servo wedges.

32. In a closed and assembled disk drive with one or more disks used to store data, a method of writing servo wedges onto at least two surfaces of one or more disks within the disk drive without the use of a servo writing machine, the servo wedges used in fine track positioning when the disk drive is in operation, the method comprising:

writing servo data in a first track on a first side of the disk;

using at least a part of the servo data as feedback to generate a position error signal that defines the motions associated with one or more components within the disk drive;

based on the position error signal, writing servo data in a first track on a second side of the disk such that a pattern associated with the servo data in the first track on the first side of the disk is substantially similar to a pattern associated with the servo data in the first track on the second side of the disk.

33. The method of claim 32, wherein the servo data in the first track on the first and second sides of the disk include servo wedges used for micro and macro positioning of the respective head over the first tracks when the disk drive is in operation, and data patterns for servoing assistance when writing servo data within subsequent tracks.

34. The method of claim 33, wherein the data patterns are between the servo wedges and out of phase with adjacent tracks, and wherein the data patterns provide the feedback for generating the positioning error signal.

35. The method of claim 34, wherein the position error signal controls the micro positioning of a recording head such that the first and second tracks are substantially similar in positioning on respective sides of the disk.

36. The method of claim 32, wherein the one or more motions are associated with frequencies from at least one of a spindle motor, base, actuator post, one or more disks or one or more heads.

37. The method of claim 36, wherein the frequencies from the one or more disks include at least one of disk flutter or disk vibrations, which are added to the position error signal and the frequencies associated with at least one of a spindle motor, base, actuator post or one or more heads are subtracted from the position error signal for predicting the opposite side head motion of the second head.

38. The method of claim 32, wherein the writing of servo data in the first track on the second side of the disk is controlled by a microactuator that moves a recording head in a radial direction.

39. The method of claim 32, further comprising:
generating a second position error signal from a second feedback signal of at least a portion of the servo data in the first track on the second side of the disk for use in positioning a first recording head; and

based on the second position error signal, controlling a micro positioning of the first recording head when writing a second set of servo data onto a second track on the first side of the disk.

40. The method of claim 32, wherein the servo data in the first tracks on the first and second sides of the disk include servo wedges used for computing an error signal for macro and microactuator tracking when the disk drive is in operation, and wherein the servo wedges are converted into half bits by offsetting first and second recording heads by a half track position relative to the first tracks of the first and second sides of the disk and writing an inverse polarity of the servo wedges initially written with the first and second reference data.

41. The method of claim 32, further comprising:

testing that the first tracks are substantially similar by positioning first and second recording heads over intermediate tracks such that only half of the first and second recording heads are positioned over the first tracks on the first and second sides, respectively; and

measuring and comparing the amplitude of the first tracks to determine if there is track encroachment or track separation.

42. The method of claim 41, wherein, during the testing of the first tracks, the servo wedges are converted into half bits by writing an inverse polarity of the servo wedges.

43. A method for writing servo data onto one or more surfaces of one or more disks within a disk drive to obtain different pitch widths on different surfaces:

identifying actual track widths generated by different recording heads in the disk drive, wherein at least some of the different recording heads generate different actual track widths;

based on the actual track widths, selecting track pitches for each of the surfaces, wherein at least some of the track pitches are different from other track pitches; and

writing on the surfaces servo data defining the selected track pitches using microactuators associated with the recording heads.

44. The method of claim 43, wherein the servo data is written without using an external servo writing machine.

45. The method of claim 43, wherein some of the surfaces have a greater data density than other surfaces.

46. The method of claim 43, wherein writing servo information comprises:

writing a reference track on a first disk surface using a first recording head of the disk drive;

using a macroactuator that is capable of adjusting the position of both the first recording head and a second recording head of the disk drive, tracking the reference track with the first recording head; and

while the first recording head tracks the reference track, using a microactuator of the second recording head to:

radially displace the second recording head from the first recording head and the reference track; and

write the servo data on a second disk surface.

47. The method of claim 43, wherein writing servo data comprises using a first recording head to write the servo data for a specified region of the first surface and using a second recording head to write the servo data for a specified region of the second surface.

48. The method of claim 47, wherein:

the servo data is written using the first recording head and the second recording head in alternating sets of rotational passes; and

some of the sets of rotational passes result in the writing of servo data that defines only one track and some of the sets of rotational passes result in the writing of two tracks.